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Improving soil chemical properties by NPK fertilizer application and residual rice husk biochar effect on irrigation paddy field

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Abstract. The research objective was to study effects of NPK fertilizer and biochar residue on soil chemical properties of paddy on second planting. Experiment was arranged in a randomized complete block design in a factorial design with four replications. Biochar consisted of two levels, i.e. without biochar residue and with biochar residue 10 ton ha^{-1}. NPK fertilizer consisted of three levels, i.e. without NPK, NPK 60 kg ha^{-1}, and NPK 120 kg ha^{-1}. The result showed that application NPK fertilizer and biochar residue on second planting increase total N 22.22%, available P 12.18%, available K 17.50%, and organic C 56.69% compare than first planting.

Keywords: soil amendment, soil fertility, rice.

Introduction

Biochar is biocharcoal of an incomplete combustion, thereby leaving the nutrients that feed the soil and can be used as an option for the management of land (Gani, 2009). Biochar is used as ameliorant and not as fertilizer. Biochar has a larger adsorption properties towards cations through surface oxidation than through adsorption by organic matter commonly (Cheng *et al.,* 2008).

Addition of biochar to the soil increases the availability of major cations and P, total N in the soil. CEC increased to 40% of the initial CEC and pH increased to one unit. The high availability of nutrients for plants is the result of increased nutrients directly from the biochar and increase nutrient retention (Lehmann and Rondon, 2006). When used as of soil with organic and inorganic fertilizers, biochar can increase productivity, as well as the retention and availability of nutrients for plants.

Research carried out in the first planting season showed a positive influence on NPK fertilizer and biochar on soil chemical properties (Sufardi *et al*, 2011), plant nutrient uptake (Nisa *et al*, 2011), and crop production (Zaitun *et al*, 2011) . NPK fertilizer 120 kg ha^{-1} can increase the availability of K in the soil and giving biochar can increase soil pH. NPK fertilizer combinations 120 ton ha^{-1} and biochar 10 ton ha^{-1} can increase the availability of P in soil (Sufardi *et al*, 2011).

To determine the impact of biochar residue and NPK fertilizer in the second planting, it was necessary to study in second planting. This study aims to examine how the effect of NPK fertilizer and residual biochar on soil chemical properties in paddy second planting.

Materials and Methods

The field experiment was established at Empetring Village, Darul Kamal Subdistrict, Aceh Besar District, Aceh Province, Indonesia on rainy season and plant Ciherang variety. The compound fertilizer was NPK Ponska (15:15:15). Biochar application at first planting used as biochar residue at second planting. .

This experiment was continue from the experiment before (first planting). The treatment of first planting consist of two factors : NPK fertilizer factor (without NPK fertilizer, NPK 60 kg ha^{-1}, and NPK 120 kg ha^{-1}), and biochar factor (without biochar and biochar 10 ton ha^{-1}). Biochar treatment on first planting as biochar residue treatment on second planting. Paddy planting on first and second planting was done at same plots.

The experimental arranged in a randomized complate block design with two factor and four replication. First factor was NPK (15:15:15) fertilizer application. F0 = without fertilizer; F1 = 60 kg ha^{-1} NPK (N = 9 kg ha^{-1}, P_2O_5 = 9 kg ha^{-1}, and K_2O = 9 kg ha^{-1}); and F2 = 120 kg ha^{-1} NPK (N = 18 kg ha^{-1}, P_2O_5 = 18 kg ha^{-1}, and K_2O = 18 kg ha^{-1}). Second factor was biochar residue application. B0 = without biochar; and B1 = 10 ton ha^{-1} (from first planting).

This research has been experiment field is continued with research in laboratory with the the following step : (a) analyze of soil and biochar samples before research; (b) field trial by planting Ciherang varietas paddy rice, NPK fertilize and biochar treatment treated as according to each plot combination treatment; and (c) soil samples analyse of final research to test to return soil chemical properties after has been conducting of research with NPK fertilize and biochar application.

Soil intake done compositely, each composite is composed 5 dot of sample taken diagonally at deepness 0-20 cm (using to soil drill). Plot size was 5 m x 5 m. Soil sample analyze has done before research to know soil chemical properties. First soil chemical properties have done before field experiment represented complete or routine analyze consisted of texture, the soil pH, organic carbon, total N, available P, available K, exchangeable cation for like K, Na, Ca, Mg Al, and H, Cation Exchange Capacity, Base Saturation, and Electrical Conductivity. The second soil chemical analyze after harvest consisted of soil pH, nutrient (N, P, K and organic C) and cation exchange capacity.

Results and Discussion

Combination of biochar residue 10 ton ha^{-1} with without NPK and NPK 60 kg ha^{-1} application can increase total N average from 0.21% to 0.25% or increase 19.05%. Application of NPK 120 kg ha^{-1} can increase total N from 0.18% to 0.22% or increase 22.22%

Interaction of biochar residue and NPK fertilizer can increase available P average from 9.03 ppm to 10.13 ppm or increase 12.18%. Sulaeman *et al.* (2005) said that soil available P 8 to 10 ppm is medium criteria and 11 to 15 ppm is high criteria. Soil available P in this experiment is medium criteria.

Table 1. Comparison of soil chemical properties at first and second planting because effect of NPK fertilizer and biochar residue application

No	Soil Chemical Properties			
	Variable	First Planting	Second Planting	Increase (%)
1	Total N (%)	0,18	0,22	22,22
2	Available P (ppm)	9,03	10,13	12,18
3	Available K (me 100 g soil^{-1})	0,40	0,47	17,50
4	Organic C (%)	1,57	2,46	56,69
5	pH	7,24	7,15	- 1,20
6	Cation Exchange Capasity (me 100 g soil^{-1})	-	46,33	-

Biochar residue 10 ton ha^{-1} application can increase soil available K in second planting. NPK 120 kg ha^{-1} apllication can increase available K from 0.40 to 0.47 me 100 g soil^{-1} or increase 17.5%. Sulaeman *et al.* (2005) said that available K value 0.1 to 0.3 100 g soil^{-1} is low criteria, 0.4 to 0.5 me 100 g soil^{-1} is medium criteria. Available K value in this experiment is include in medium criteria.

Commonly biochar resiude application at second planting can increase soil organic C. Organic C value in first planting was 1.57% and in second planting was 2.46% or increase 56.69%. Sulaeman *et al.* (2005) said that organic C value 1 to 2% is low criteria, 2 to 3 % is medium criteria. The experimental result showed that organic C in first planting was low criteria and increase to be medium criteria in second planting. This result indicate that biochar residue has shown its effect to soil in second planting.

Soil pH of second planting on biochar residue 10 ton ha^{-1} was lower than soil pH of first planting. Decreasing soil pH of second planting because biochar can stabilize soil pH to be neutral criteria for optimum pH for optimum paddy growth. Biochar application can also provide a good growing medium for various soil microbes, so of soil microbial activity can increase the water and nutrient retention in the soil, thus making the pH to neutral.

Sulaeman *et al.* (2005) said that soil pH 6.6 to 7.5 is neutral criteria, so soil pH of second planting was neutral criteria. Soil pH in neutral criteria is very helpful in dissolving

nutrients so it is easy to use by plants. Besides being able to influence the solubility of nutrients, pH also plays an important role in the development makroorganisme and microorganisms. Makroorganisme existence and microorganisms are very important because they can provide nutrients that plants need. In general, microbial activity goes well at a pH of about 6.5 to 7.0.

Sulaeman *et al.* (2005) said that soil CEC value of 100 grams of soil 25-40 me 100 gram soil^{-1} criteria included high,> 40 me 100 gram soil^{-1} including very high criteria. Thus, the value of soil CEC on second planting criteria included very high**.**

Conclusions

NPK fertilizer and biochar residue application on second planting increase total N 22.22%, available P 12.18%, available K 17.50%, and organic C 56.69% compare with first planting.

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References

Cheng, C.H., Lehmann J. and Engelhard M. 2008. Natural oxidation of black carbon in soils: changes in molecular form and surface charge along a climosequence. Geochimica et Cosmochimica Acta 72, 1598-1610.

Gani, A. 2009. Biochar utilizatiom for agricultural land improvement. Iptek Tanaman Pangan (ISSN 1907-4263) Vol. 4 No. 1, Juli 2009. p:33-48.

Lehmann, J. and M. Rondon. 2006. Biochar soil management on highly weathered soil in humid tropics. p: 517-530 In Biological Approaches to Sustainable Soil Systems (Norman Uphoff *et al* Eds.). Taylor and Francis Group PO Box 409267 Atlanta, GA 30384-9267.

Nisa, K., Sufardi, Zaitun, Chairunas, A. Gani, P. Slavich, and M. McLeod. 2011. Effect of NPK and biochar application to nutrient absorption N, P, and K of paddy rice. Proceeding of National Seminar of Indonesian Biology Association. p166-168. November 26-27, 2011.

Sufardi, K. Nisa, Zaitun, Chairunas, A, Gani, P. Slavich, and M. McLeod. 2011. Effect of NPK fertilizer and biochar application to soil chemical properties of irrigation paddy. Proceeding of The Annual International Conference : Building Aceh through Science: Dignity and Prosperity. Banda Aceh. p55-58.

Sulaeman, Suparto, and Eviati. 2005. Analysis of plant chemical, water and fertilizer. Agriculture Research and Development Institution. Agriculture Depatment. Bogor.

Zaitun, K. Nisa, Sufardi, Chairunas, A. Gani, P. Slavich, and M. McLeod. 2011. Effect of NPK fertilizer and biochar applications on growth and yield of irrigation rice. Proceeding of The 7th Asian Crop Science Association Conference: Improving food, energy, and environment with better crops. Bogor, Indonesia, 27-30 September 2011.